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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	Uri Cohen		
Serial No.:	10/688,333	Filed:	Oct. 17, 2003
Examiner:	Wilkins III, Harry D.	Group Art Unit:	1753
Title:	Methods and Apparatus for Activating Openings and for Jets Plating		

SUBMISSION OF APPELLANT'S REPLY BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

Transmitted herewith is a Reply Brief to the Examiner's Answer of 06/05/2008.

Respectfully submitted,

Date: August 1, 2008

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Attached: A Reply Brief.

CERTIFICATE OF MAILING under 37 C.F.R. 1.8(a)

I hereby certify that this correspondence is being deposited on August 1, 2008 with the United States Postal Service as first class mail, with sufficient postage, in an envelope addressed to Mail Stop Appeal Brief-Patents, Commissioner for Patents, P.O. 1450, Alexandria, Virginia 22313-1450.

_____ August 1, 2007
Uri Cohen Date of Signature

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant:	**Uri Cohen**
Title:	**Methods and Apparatus for Activating Openings for Jets Plating**
Serial No.:	**10/688,333**
Filed:	**October 17, 2003**
Examiner:	**Wilkins III, Harry D.**
Group Art Unit:	**1753**
Date:	**March 7, 2008**

RPLY BRIEF

CERTIFICATE OF MAILING under 37 C.F.R. 1.8(a)

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Uri Cohen

August 1, 2008
Date of Signature

Table of Contents

Mistakes and Errors in the Examiner's Answer of 06/05/2007 ("EA")

Legal Errors

A. **Legal Error**: The Examiner argued in his Examiner's Answer of 6/5/2008 ("EA"), on p. 9: "*the teachings of Tzanavaras et al at col. 3, lines 13-22 are noted by the examiner, but such passage does not constitute an actual "teaching away". A proper "teaching away" is a statement within a prior art reference that specifically states that doing "A" is not desirable or would lead to bad results. This is clearly not the case when it comes to the passage of Tzanavaras et al. Tzanavaras et al merely state that sufficient agitation is achieved, and does not teach against applying any other solution to help aid in agitation or wetting.*" Appellant assumes that by "A" the Examiner refers to a prewetting step of the openings by ultrasonic or megasonic vibrations.

Appellant submits that, although a specific statement by a reference that "A" is not desirable or would lead to bad results is one way to evidence teaching away, it is not the only way in which a reference can teach away. For example,

> As set forth in Ormco Corp. v. Align Technology Inc., 463 F3d 1299 [79 USPQ2d 1931] (Fed. Cir. 2006) at 1940: However, a reference that "teaches away" from a given combination may negate a motivation to modify the prior art to meet the claimed invention. See, e.g., *Medichem, S.A. v. Rolabo*, S.L., 437 F.3d 1157, 1165 [77 USPQ2d 1865] (Fed. Cir. 2006). 'A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.' *In re Kahn*, 441 F.3d at 990 (quoting *In re Gurley*, 27 F.3d 551, 553 [31 USPQ2d 1130] (Fed. Cir. 1994)) (internal quotation marks omitted).

Thus, Tzanavaras et al. teaches away from the invention because a POSITA, upon reading Tzanavaras et al., "*would be led in a direction divergent from the path that was taken by the applicant.*" Specifically, this so because pending claims require[1] an ultrasonic or megasonic electrolyte prewetting step prior to commencing the electroplating step, and Tzanavaras et al. teaches[2] that electrolyte jets alone provide efficient agitation (and hence full electrolyte

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[1] Specifically, the pending claims require "*applying ultrasonic or megasonic vibrations to the substrate, and after commencing step (b): ... applying an electroplating current ... .*"

[2] See, for example, Tzanavaras et al., col. 3, lines 13-22: "*The impinging powerful jets create turbulent flow at the substrate's surface, thus providing efficient agitation and replenishment in all areas, including complex mask features with varying depth and opening sizes. High aspect ratio opening areas receive a similar degree of agitation (and replenishment) as areas of lower aspect ratios. Even features with the deepest and smallest openings*

penetration and wetting) inside all openings, including wide and narrow, and low and high aspect ratio openings. Tzanavaras et al. further discloses (at col. 1, lines 34-38) that the width of the openings may vary between about 5-75μm (which includes Downes et al.'s range of about 25.4-50.8μm). This teaches away from an essential element of the invention because, upon reading Tzanavaras et al., a POSITA would be led in a direction divergent from the path that was taken by the Appellant; that path being to provide an ultrasonic or megasonic prewetting step prior to jets electroplating. The POSITA would be led in the divergent direction, because Tzanavaras et al. teaches that electrolyte jets alone accomplish efficient agitation (and hence full electrolyte penetration and wetting) inside all openings, including wide and narrow, and low and high aspect ratio openings. The POSITA would thus understand that adding an ultrasonic or megasonic prewetting step would be unnecessary, and costly (due to additional equipment and process complexity). As such, the POSITA would be led in a direction divergent from the path that was taken by the Appellant.

In addition, because Tzanavaras et al. teaches away from the invention, it negates a motivation to modify prior art (including Downes et al.) to meet the claims of the invention.

B. **Legal Error**: The Examiner argued (see EA, pp. 9-10): "*Appellant has argued the following points. ... (b) Downes, Jr et al teach away from the claimed invention by teaching that the wetting step occurs in a different composition and chamber than a subsequent coating step. In response, as above, a teaching of a preference by a prior art reference should not be construed as a teaching away from the alternatives by the reference. Further, with respect to this feature, the wetting of the substrate in Tzanavaras et al is done in the electrolyte, with the electroplating chamber. The wetting of Downes, Jr et al occurs (see paragraph 33) that the disclosed arrangement (figure 1) is exemplary of a system to ensure wetting prior to a subsequent wet chemical process. Downes, Jr et al never state that the wetting liquid cannot be the same liquid as is used in the subsequent wet chemical process.*"

(having the highest aspect ratio) receive essentially the same degree of agitation as areas of lower aspect ratios." See also col. 3, lines 24-34: "*Each mask opening on the (stationary) substrate is subject to periodic pulsating jets produced by the RAJA. This pulsating action allows for pressure relaxation and outflow of depleted solution from the opening during periods when the jets are away. During periods when the jets are impinging on the openings, fresh solution is injected into the openings. The turbulent flow and pulsating action prevent the formation of stagnant (and depleted) electrolyte solution in deep and narrow mask openings.*"

In response, Appellant repeats the discussion set forth in **Legal Error A** above. Downes et al. does not specifically exclude an ultrasonic prewetting step in the same (electrolyte) liquid and (ECD) chamber as in a subsequent plating step. However, Downes et al. teaches away from the invention because a POSITA, upon reading Downes et al. and Tzanavaras et al., would be led in a direction divergent from the path that was taken by Appellant.

In his Office Action of 1/25/2007 the Examiner acknowledged (see p. 2):

> Applicant's remarks with respect to at least claims 4 and 9 [claims 4 and 9 required the activation or wetting solution to be the same as the electrolyte] with respect to a lack of motivation from Downes, Jr. et al to perform the wetting and electroplating steps with the same solution is found persuasive and the rejection grounds of claims 4 and 9 utilizing Downes, Jr. et al have been withdrawn.

Thus, the Examiner has already agreed that Downes et al. lacks a motivation to perform ultrasonic prewetting in the same solution as the electrolyte. In response to that Office Action (of 1/25/2007), Appellant amended Claims 1, 3-5, and 29-32 to require "*wherein the activation or wetting solution is the same as the electrolyte, and wherein steps (a), (b), (c), and (d) are performed in the same chamber.*" In contrast with these limitations, Downes et al. teaches[3] the use a different prewetting solution from the electroless plating solution, and to perform the prewetting step in a separate chamber from the electroless plating chamber. A POSITA would have understood that, because Downes et al. discloses an electroless copper deposition process, performing an ultrasonic prewetting step in the same electroless plating solution (in the same plating chamber) would lead to deleterious electroless copper deposition before air bubbles are removed from the openings. As such, this would defeat the entire purpose of the ultrasonic prewetting step. If, however, the POSITA would have considered using an ultrasonic or megasonic prewetting step prior to jets-electroplating, the POSITA would have been assured by Tzanavaras et al. that electrolyte jets alone are sufficient to provide full wetting inside all openings. Thus, the POSITA would have understood that: (i) electroless copper deposition process may require an ultrasonic prewetting step (in a different solution and chamber) prior to

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[3] See paragraphs [0022], [0028], [0031], [0033], and [0040]. For example, paragraph [0022]: *"The continuous water exchange and flow of the liquid ... thus imparting a further cleaning function to the pre-wetting process. This, in effect, will prevent any drying or dewetting of the articles prior to subsequent electroless copper plating."* And paragraph [0040]: *"Upon completion of the prewetting process, which maybe a first step preceding an electroless copper plating or precleaning process sequence, the panels may be conveyed to a subsequent process tank (not shown) whereby typical tank-to-tank transfers may entail a period of time of 1 to 2 minutes. Within this time frame,*

the deposition step; and (ii) the jets-electroplating process does not need any ultrasonic or megasonic prewetting step prior to the electroplating because electrolyte jets alone provide full wetting inside all openings. As such, the POSITA, upon reading Downes et al. and Tzanavaras et al., would be led in a direction divergent from the path that was taken by Appellant. As such, Downes et al. and Tzanavaras et al. teach away from the invention.

Technical Mistakes

A. Technical Mistake: The Examiner stated (at EA, p. 10): "*The present invention relies on unexpected results shown in the declaration under 37 CFR 1.132 that it is "wide" trenches and vias that have problems with wetting, as opposed to the "narrow" trenches and vias taught by Downes, Jr et al. In response, first, the data provided is not commensurate in scope with the claims. Or more accurately, the claims do not provide any range of sizes of openings on the substrate, and the data indicates that only specific sizes of openings have the described wetting problems. Second, the absolute width size of the features described by Appellant in the 132 declaration which had problems were 17 microns and 55 microns (see Table 1). The "narrow" features described by Downes, Jr et al have width sizes in the range of 0.001-0.002 inches which equals about 25-50 microns. Therefore, there is complete expectation by one of ordinary skill in the art of the wetting problem with the size of features described by Appellant in the 132 declaration.*"

In response, Appellant submits that he relied on the experimental data in his 1.132 declaration to demonstrate his unexpected discoveries: (a) that contrary to the teaching of Tzanavaras et al., the application of high pressure electrolyte jets alone is insufficient for full wetting inside deep openings; (b) that contrary to the teachings of Downes et al. and Tzanavaras et al., insufficient electrolyte wetting is more prevalent inside wider openings than inside narrower openings (**a newly discovered wetting problem**); and (c) that the source of the newly discovered wetting problem (that electrolyte wetting inside wider openings is more difficult than inside narrower openings) is due to smaller capillary forces inside wider openings than inside narrower openings. Contrary to the Examiner's assertion that the experimental data in the 1.132 declaration showed a wetting problem only in the 17-55μm wide vias, Appellant submits that (as

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it would be rather difficult to dewet the already wetted vias or holes which have a capillary-like wetted surfaces preparing these for subsequent cleaning and electroless copper plating.

is clearly set forth in the declaration) the experimental data was obtained using high pressure electrolyte jets alone (with no ultrasonic or megasonic prewetting step), and via widths ranging between 6μm and 55μm. Appellant further submits that the experimental data showed that vias of all widths had a wetting problem to some extent; which increased with increasing vias width. Even the 6μm wide vias (FIG. 2D) had a wetting problem; indicated by voids seen at the bottom of the vias. FIG. 2D shows that, although in some 6μm wide vias the wetted depth extended almost to the bottom (close to ~100%), these vias still had a wetting problem. The wetting problem was more severe in the 9μm wide vias (FIG. 2C), where wetted depth was only ~87%. The wetting problem was even worse for the 17μm and 55μm wide vias, where the wetted depth was only 50% and 48%, respectively. Thus, contrary to the Examiner's assertion that only specific size (17-55μm) of openings have the wetting problem, the experimental data indicated that the wetting problem was in all sizes of vias (in Table **I** of the 1.132 declaration), but was more prevalent in the wider vias. In contrast, **the prior art references assert[4] that the wetting problem is more prevalent in narrower openings than in wider openings**.

The Examiner stated that, because the features of Downes et al. have width size of about 25-50μm, there is complete expectation by a POSITA of a wetting problem with the size of vias described in Appellant's 1.132 declaration. However, Appellant notes that the Examiner relied upon Tzanavaras et al. as the main reference[5] for his rejection, not upon Downes et al. As set forth in **Legal Error A** above, Tzanavaras et al. asserts that electrolyte jets alone provide full wetting inside all openings. Therefore, a POSITA would have understood from Tzanavaras et al. that, when using electrolyte jets, there would be no wetting problem in any of the sizes disclosed

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[4] See, for example, Tzanavaras et al., col. 3, lines 17-22: "*High aspect ratio opening areas receive a similar degree of agitation (and replenishment) as areas of lower aspect ratios. Even features with the deepest and smallest openings (having the highest aspect ratio) receive essentially the same degree of agitation as areas of lower aspect ratios.*" See also Downes et al., paragraph [0024]: "*Although so-called panel bumping and panel tilting have been employed in the technology in order to remove air from drilled holes prior to and/or during the plating processes, this maybe somewhat effective for larger-sized holes or vias, but remains essentially ineffective for smaller holes or vias, particularly those possessing high-aspect ratios.*" And Downes et al., paragraph [0042]: "*In the event that the holes are small diameter sized with only small aspect ratios, rather than employing the ultrasonic sender array **26** in the prewetting tank **24**, it may be adequate to simply employ mechanical vibration or agitation in the fully degassed tank **24** such as through well-known mechanical devices in order to dissolve all of the residual air bubbles remaining in the liquid or water and in the holes and allow them to discharge through the drain **44**.*"

[5] See EA, p. 4: "*it would have been obvious to one of ordinary skill in the art to have applied, prior to commencement of electroplating in the process of Tzanavaras et al, ultrasonic or megasonic vibrations to the substrate of Tzanavaras et al for the known purposes of ensuring adequate wetting of openings in the surface of the substrate in the size range of 25.4-50.8 microns.*"

by Tzanavaras et al. In this regard, Appellant further notes that Tzanavaras et al. discloses[6] openings with widths in the range of 5-75μm, which fully overlaps the range used in Table I of Appellant's 1.132 declaration.

SUMMARY

The Examiner rejected pending Claims 1-10 and 29-43 of the invention on the grounds that the elements of the invention can be found in combinations of prior art references. For this, the Examiner argued the following theory: (a) Downes et al. disclosed a need to remove air bubbles from drilled vias by an ultrasonic prewetting step (prior to electroless plating); (b) Tzanavaras et al. disclosed a jets electroplating process (but no ultrasonic or megasonic prewetting step); and (c) it would have been obvious to a POSITA to perform the ultrasonic prewetting step of Downes et al. in the jets electroplating electrolyte and chamber of Tzanavaras et al., in order to provide wetting inside the openings in the substrate of Tzanavaras et al. However, to justify his theory, the Examiner **ignored** the following evidence that contradicts it. For example, the Examiner (a) ignored the evidence that Tzanavaras et al. teaches away from essential elements of the invention; (b) ignored the evidence that Downes et al. and Tzanavaras et al. teach away from other elements of the invention; and (c) ignored the evidence that Downes et al. lacks any motivation to perform an ultrasonic prewetting step in the same solution as the electrolyte.

Respectfully submitted,

Date: August 1, 2008

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[6] See Tzanavaras et al., col. 1, lines 34-38: "*While the narrow pole-tip (about 5-7 μm wide) is located on a flat surface, the wide (about 50-75 μm) back-yoke is located over an elevated step (comprising coil and insulation layers), about 10-15 μm above the pole-tip.*"